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The American Biology Teacher

VOL. 4 FEBRUARY, 1942 NO. 5

NATURE STUDY ISSUE

Special Articles on Nature Study by Teachers in Service

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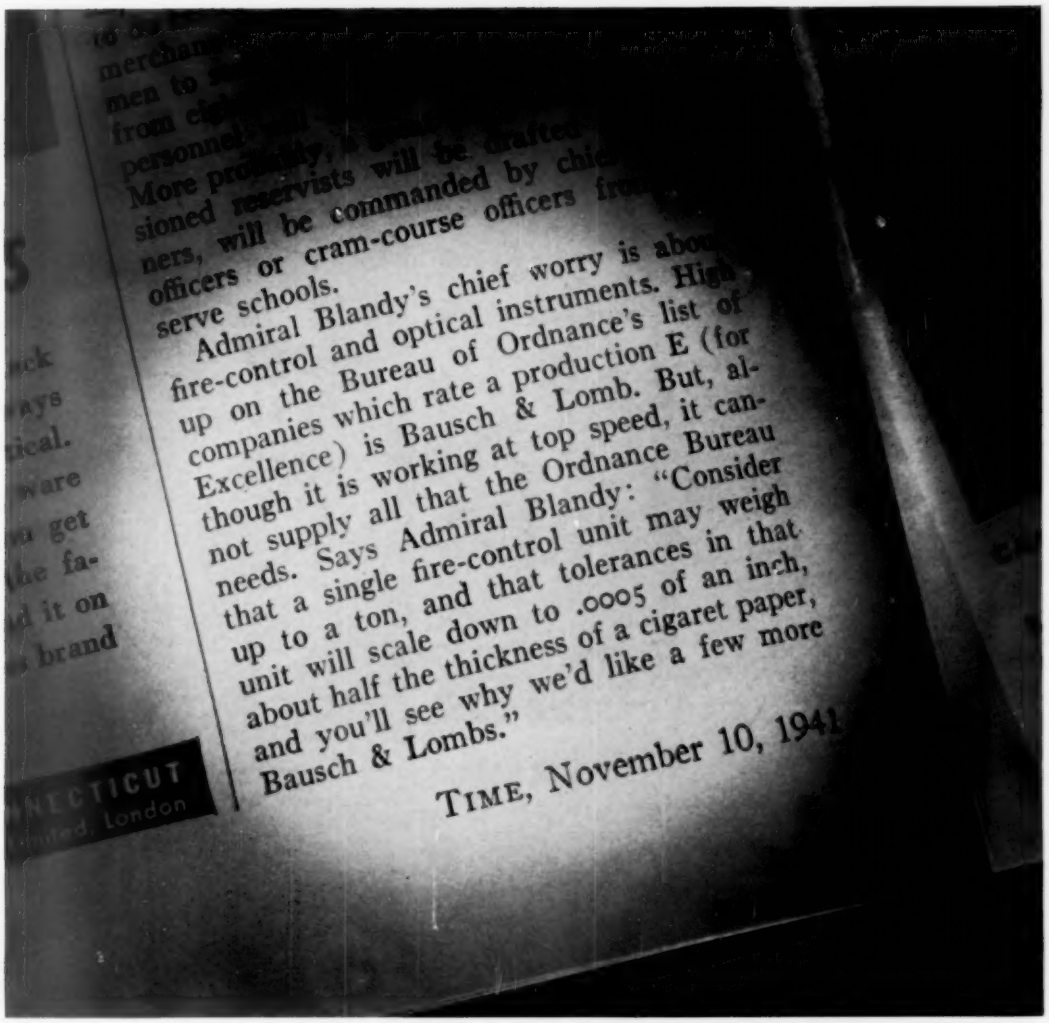
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Vol. 4 FEBRUARY, 1942 No. 5

Special Articles on Nature Study by Teachers in Service

NATURE STUDY AS A HOBBY

The average course in biology as taught in high school must of necessity follow the outlines of a textbook and workbook. Also the training of the teacher has an influence on the class and its discussions. Training in general biology provides an excellent background for teaching the average high school course; but it does not give enough specific information to save the teacher from being asked many embarrassing questions about nature study. One boy on the road to school sees a bird he has never seen before. Previous to this time he had never noticed the difference in birds, but a slight touch of biology has stimulated his interest. Eagerly he enters the room and tells the teacher about the new discovery. He gives a sketchy description of the bird and asks the name of it. Now comes the crucial moment. If the teacher is familiar with the birds of a region then the question offers few difficulties, but if the teacher is only familiar with book knowledge and cannot identify the bird then a fascinating hobby or career may be lost to the student. The same procedure applies to rocks, insects, flowers, and trees. Nature has a varied and interesting story to tell but will not give it up voluntarily.

My hobby, along with my teaching, has for a long time been nature study. Any biology text gives plenty of anatomy, health, hygiene, etc., all of which can be taught in the laboratory and from charts. Most biology workbooks have charts by which students can keep an account of the various birds which they see. I have found that students fill these in by copying from each other or by asking me. I decided that it was necessary that I get to know Montana birds, so I started in to get acquainted with them. I was utterly amazed to discover that I was surrounded by all varieties of birds and didn't know it. Here in the Montana uplands the study of birds through the seasons soon becomes fascinating. Dur-

ing the very coldest period of winter we are often visited by the Bohemian Waxwing and the Redpoll. Snowbirds are with us all winter long as are Magpies, Clark's Nutcrackers, and English Sparrows. With the coming of spring, and by the way spring came in February this year, the Robins and Bluebirds arrive to be soon followed by Meadowlarks, Crows, Song Sparrows, Vesper Sparrows, and the Western Evening Grosbeak. Summer finds the Western Tanagers, the Goldfinches, the Blackbirds, and Hummingbirds all present and busy. Autumn brings flocks of Grasshopper Sparrows, and great flights of ducks and geese. After one gets to recognize the general species, then comes the fun of studying each bird through field glasses so that the sub-species can be recognized. Our mountain birds often vary from the general color pattern. I could write much about birds, but I want to go on.

Here we are fortunate in living close to Yellowstone National Park, and after the regular tourist season and before snow closes the main roads the Park becomes a wonderful place to study wild animals. With field glasses one can study mountain sheep, pronghorn antelope, elk, moose, and bison. Often also it is possible to approach some of these animals close enough to photograph them.

In the mountains here if one is patient enough to remain on a peak for long periods of time he may be rewarded by glimpses of black-tailed deer and of black bear in the canyon below. In the streams many beaver are yet to be seen as are muskrats. By use of stealth these latter two animals may be observed in their daily activities.

Porcupines, kangaroo mice, deer mice, meadow mice, ground squirrels, and tree squirrels are all common. Ground squirrels however are being relentlessly poisoned by crews of men each spring, so that soon their cheery chirps will be a thing of the past.

Insects and arachids are very interesting when a person begins to study them. To the average person there are just two classes—bugs and spiders. Time and again some student arrives with a "bug" in a bottle and wants to know what it is. Thanks to a small personal library it doesn't take long to classify the creature. Insects are my weakest subject but I intend to do a lot of further work on them.

Flowers and plants are an especial delight to study. My wife shares this delight with me and we have spent hours in classifying flowers. We do not press them but rather my wife sketches them in color, the details to be filled in at her leisure. We have dug up a tremendous number of native plants and flowers and transferred them to our own backyard garden where we have had phenomenal success in getting them to grow.

Thus you can see that Nature Study is to me just what it means. Studying Nature is the most satisfying hobby and one of the most healthful ones that can be achieved. I hope that over the course of years I have actually taught students to appreciate Nature.

Harry E. Sawyer,
Clydepark Public School,
Clydepark, Montana.

NATURE NOTES FROM NEW ENGLAND

I have taught biology in New Hampshire six years but never the same course twice. This is because I have new ideas and give up old ones, no two classes are the same, different localities offer different possibilities, and varying degrees of teaching load and available equipment dictate different procedures.

We often use one-day exhibits of unusual plants and animals, such as a befuddled woodcock or damaged whip-poor-will, which are of great interest to pupils. Farm boys who trap are glad to exhibit animal skins.

We use as much as possible more permanent nature materials, such as aquarium, terrarium, ant colony, plant table, earthworm colony. To watch a frog catch flies or eat worms is interesting. Some teachers find bee hives excellent. One has a tame monkey. Snakes and rats may be kept all winter as well as frogs and salamanders.

We have tried digging up one good specimen of each spring flower studied, potting it on the spot, and keeping it in the laboratory several weeks for pupils to study.

A fall collection of ferns or of bird nests is as worthwhile as one of flowers, leaves, kinds of wood, etc.

A classroom chart of spring birds, giving date first seen and pupil's name, arouses competition and can be kept accurate by having each enthusiast talk with the teacher before adding the name. More than forty can easily be listed.

Every field trip should be planned and the route traversed by the teacher in advance. If two male flickers stage a fight on the day of the trip, it helps to teach pupils to keep their eyes open. We try to take one fall trip to collect pond water for laboratory study and to name fall flowers; one winter trip to study evergreens and identify deciduous trees by bark, bud, and shape; spring flower trips along a river; to meadows; to meadows later to show plant succession; to swamp and pasture; to woodlands; and on a new route to quiz knowledge of a sampling of these plants plus any birds that show themselves or sing during the quiz trip, if previously studied. In one town we took a fall trip to a farm where rabbits, pigeons, peacocks, and several kinds of pheasant and quail were kept.

After school are optional Saturday hikes, evening trips in spring to study spring peepers, etc., and a number of early morning (start 5:30 or 6) bird walks limited to six pupils at a time.

It may prove helpful to type a list of the common birds, mammals, insects, fishes, amphibians, reptiles, trees, flowers, etc., of an area, and give a copy to each pupil. Good reference books should be available, which will probably be supplied largely by the teacher and pupils except in large systems. State libraries are often of help.

Successful nature study work seems to demand a well-informed and enthusiastic teacher, some reference material, and careful planning. Details of managing and giving credit for nature study both during and outside the school time should be up to the teacher. Local enthusiasts on birds, moths, or other nature hobbies can be of assistance. Most birds I know were self-taught with opera glasses, a few books, and notebook. Spiders, mushrooms, mosses, and uncommon insects are still on my "to be studied" list.

Alva Z. Allen,
Goffstown High School,
Goffstown, N. H.

NATURE STUDY IN THE WEST

Biology instructors should fulfill the one big objective of biology teaching which is: "to make the course a dynamic and living one" through the definite correlation of the subject-matter taught with that of Nature Study. The instructor should stress the adaptation of the science program to the local environment —and it is at this point that the field of

Nature Study plays a very important role. Through the medium of field trips, and enhancing of individual collections the student is made better prepared and able to enjoy Mother Nature's laboratory.

The biology teacher before planning a field trip with the students, should study carefully the particular habitat, so as to be able to better understand what to emphasize for pupil observation, and also better prepared to answer any questions which may arise. In field work the student begins to appreciate his environment, he becomes alert and observant. Particular stress is placed upon the correlation of the subject-matter to the out-door laboratory. The great-outdoors, when used wisely and accurately, becomes the students' greatest laboratory.

Our city is located in a very interesting area in which a person can carry out interesting surveys with the students on various phases of Nature Study. The lovely Yellowstone and Boulder rivers present an excellent opportunity for the study of birds, frogs, water insects, water plants. Students are encouraged to make individual hikes through this particular habitat to observe the various forms of life, as well as securing accurate data for their studies.

Whether the field trip be one during the laboratory period, or during an activity period, the student is encouraged to bring to the laboratory any specimens which have been collected, either to be placed in our permanent collection displays or used as laboratory materials.

Another very interesting habitat group has been the mountain fauna and flora. In the fall of the year the students take an all day excursion into the mountains —the majestic Crazy Mountains. Here the individual student has an excellent opportunity to study the ecological succession of plants and animals. Many interesting studies of bird-life, plants, and insects are made during the day. A great deal of material is collected which is to be used as laboratory material. Insects are mounted, classified, and then placed into a permanent display box. The plants are also pressed and added to the class herbarium.

In our biology course particular attention is given to the study of birds in a unit entitled "Ornithology." This study is presented with the viewpoint, that in this very interesting area, the bird-life is abundant during most of the seasons of the year; not only abundant, but varied. Particular study is given to the following points: bird coloration; adaptations of feet, bill, etc.; economic value; aesthetic value. Birds which have been found dead are brought into the laboratory where skins are made of them, and a study made of their stomach contents.

The terrarium includes various types of mosses and small ferns. The live materials includes frogs, newts, and water lizards. This year the students have been able to study the life cycle of the mosses—being able to see the sporophytic generation give rise to the gametophytic generation.

Biology field trips should not be limited to certain seasons of the year, but should be encouraged during the entire school year, and also during the vacation months. Students are interested in having explained to them what certain insects do during the winter months. To make the explanation much more interesting and meaningful the instructor can plan a field trip into areas where insect larvae may be collected under the bark of trees; such first-hand observations appeal to the students, and encourages them to be more observant of their surroundings.

If we can get the enthusiasm and the interest of the boys and girls, and a desire to learn more and to explore the unknown, if we can make them open their eyes to the wonders of their natural surroundings, and give them a desire to conserve it, if we can give them a respect for life, and an appreciation of the beauties of nature, then we can honestly say that we have made a success of our biology teaching.

EDWARD A. PALCICH,
Sweet Grass County High School,
Big Timber, Montana.

BIOLOGY IS LIFE

Nowhere in all the school should there be more life than in the biology laboratory. Biology is life; and for this reason, it must be dynamic. Biology cannot be properly taught, therefore, without the essence of the subject, living things, being in conspicuous places in the classroom. Biology can be taught in a lifeless classroom; it can also be taught in a lifeless manner, and often both go together. A biology laboratory ought to be teeming with life. Ofttimes, this is either impossible, impractical or expensive. Any real teacher, however, can find some living things easily cared for and exhibited in the classroom. Nature study for the rural teacher is no real problem, and the urban teacher can usually secure a few laboratory animals from universities, supply houses, or from the surrounding countryside.

The expenses of care and feeding are fairly low. The students love to bring food for the animals and they love to feed them. Storekeepers in the neighborhood will give large quantities of their scrap meats and vegetables for little money, when they know it's for feeding the pets. They will even give you a box of sawdust for the cage floors. Students will help keep the cages clean and in good condition. Every time a student participates in any of the activities necessary for the maintenance of these animals, he learns something. More conservation is taught this way than through books.

In this paper, I am emphasizng the animal life in Nature Study. Perhaps another person will write about the wild plants. My experience is drawn in part from teaching nature study at Camp Wooster in Illinois. Here I had a large log cabin with a huge fireplace. About 50 youngsters from 9 to 17 years of age flocked into the cabin daily. The secret of this attraction was simply the large number of snakes, birds, frogs and turtles, lizards and small mammals found in the vicinity. In the outdoor cages, we had a ferret, two black crows, a duck and some pigeons. The campers did not just look at the animals. They were attracted by something else too. There were attractive signs on each exhibit. For example, they read: "Have you ever seen a bloodsucker? Well look carefully into this jar." And they would look. Also, "Did you ever see a milk snake drink milk from a cow? Neither have we nor anybody else, but it is still called a milk snake." Or, "Garters aren't made out of garter snakes either." I also went out into the surrounding area very frequently and obtained different animals to change off the exhibits. This keeps the youngsters interested and draws them in again and again. Feeding day for the snakes is a special occasion and it is amazing to see the kids push and fight to get up close to the snake cages. A few field mice or leopard frogs furnish the onlookers with enough amusement and enough questions to result in real learning and real nature study teaching.

Much of the above can take place in the classroom in school just as well. Interesting live animals in the laboratory, fascinating signs to attract the students' attention to the exhibits, new exhibits occasionally, and no teacher need worry about teaching the subject. The subject will teach itself. Frequently it is necessary for the teacher to restrict the questions asked, for sometimes one question follows another so rapidly that the teacher finds himself caught short for time. However, no teacher ought to worry about getting off the subject when students are asking things from their hearts.

There are certain objectives of nature study teaching which make it worth the trouble and time necessary to its development. One objective is to acquaint the pupils with different animals and to teach the pupils to handle them in the proper ways so that no animal will be tagged with the title "wild" or vicious. Another is to develop an affection within the student toward the animals so that the problem of conservation need not be taught disconnected from its contents. People generally do not sympathize with anything they do not know. It is much easier for a non-dog-owner to kill a dog than for a dog-owner to do this. Third, in observing the animals, much is learned regarding food, animal habits, animal behavior, necessity for cleanliness, unbalanced diets, growth and development. We have correlation in our subject just as all the parts of one animal are correlated. We have thinking in relation to real situations just as we have in the world outside of school. We have more learning than teaching. And best of all, it's down to earth.

Alfred Novak,
Wendell Phillips High School,
Chicago, Illinois.

RECORDING NATURE SPECIMENS BROUGHT TO THE CLASSROOM

To give proper credit to pupils who bring in nature specimens a card system is used. When a pupil brings in a specimen he himself writes the name on his card. But first he must have identified the object.

The cards used are blank 4 × 6 with the pupil's name at the top. The cards for each section are arranged in alphabetical order, held by a rubber band bearing a tag with a section number. I keep these cards in my desk drawer. When a pupil or pupils have something to record I toss out the bunch. The pupil finds his section and card. If the class period starts the pupil takes the bunch or his card to his seat, returning the cards later. The pupils have been very conscientious in their recordings, many times not even needing to be reminded to do it.

At the end of the grading period it is a matter of moments only to go through the cards, a draw a short line to indicate the stopping place, under the line to record the credit, then to record the credit in the grade book. Each item is credited according to its value, usually 5 or 10, sometimes 0. The total credit given to each pupil in each grading period is an arbitrary limit to balance with recitations, tests and other work.

Originated to take care of the many specimens, especially insects, brought in in the fall before pupils' names have become familiar the system has proven so successful and so easy to operate that now the pupils record on their cards all types of individual activity, such as bringing in laboratory material that has been requested, specimens of all kinds, pictures, clippings and work done. It is

very efficient for a round of activity that is optional and continued over a period of time, such as time spent in reading nature magazines for bibliographies or in the spring for recording sets of staminate and pistillate flowers from forest trees as they were found. The recording takes no class time, no effort on my part and all due credit is received.

A successful follow-up has been to have the pupil immediately label his specimen, add his name to the label, and himself set the object up on display to the whole class. It is also of interest in the spring to have a moth or a butterfly emerge from a case that had been labelled by the pupil in the fall.

DELIA REDMAN,
High School,
New Haven, Indiana.

ONE WAY OF TEACHING INSECTS

This project has been used with a student teacher group of College Freshmen but should serve very well to motivate a "Unit on Insects" in a High School Biology Course.

OUTLINE OF PROCEDURE

A. *Time:* Preferably early fall when insects are available.

B. *Teacher's Approach:*

This must be very carefully planned since upon it depends the success of the project. A motivation talk, illustrated if possible, is given on the first day. The material is so arranged that many interesting problems are suggested to the students and these are so strikingly presented that a desire to investigate is created. No definite outline of such a talk can be given here, because, in order to be effective, it must embody the teacher's own knowledge of the subject, his interest in insects and enthusiasm in presenting the material. This means that just enough about a suggested topic will be said or shown on the screen to arouse interest but no more. A wise selection of pictures is important.

C. *Class Expression:*

1. After the approach, the teacher is not to be disappointed if the response is not spontaneous. Certain groups like a few minutes to think. However, if the students have been mentally aroused, they will quickly enough respond to the teacher's query, "Is there anything more you would like to know about insects?" It may be that those interesting statistics, typewritten on a card and projected or perhaps typed on cellophane and made into a lantern slide, have evoked a desire to investigate the work of the Bureau of Entomology; that picture of the Anopheles mosquito which was labeled "Carrier of Malarial Fever" will prompt a report of the work of Walter Reed and others and incidentally the activities of other mosquitoes may be questioned. Again, the scene in which fruit trees are being sprayed will suggest the insect pest and bring out numerous topics for study.

If the group is large, a secretary should be appointed to write down the topics as they are selected. She should be provided with a list of names of the students alphabetically arranged with sufficient space for topics.

2. Teacher and secretary then go over the list and organize the topics, eliminating such as may not be practical or which may overlap other and better investigations. This may necessitate making new suggestions to some students, which, of course, must be tactfully done in order not to destroy student initiative. Interesting groupings are sometimes possible which enhance the teaching value of subsequent reports.

3. Students who do not like to make reports may volunteer to construct models, vivaria, ants' nests, insect traps or bee frames; to make charts and collections—all of which are excellent. Others may be interested in making lantern slides or in compiling statistics in the form of telefacts. Occasionally, a very good student offers to plan a field trip or knows a specialist in the field whom he wishes to invite to talk to the group.

D. *The Work:*

Students are now directed to start their investigations. Available literature is pointed out; places of interest indicated and the suggestion made that letters be sent to various Experimental Stations and Departments of Agriculture asking for information. To prevent waste of time here, it is well to have on hand lists of the publications issued by these departments. Many of these are free and others sell for a few cents.

E. *Conclusion of the Project:*

After a definite time has elapsed during which the students have secured their material, worked out their parts of the project and written up their findings, each student makes a report or gives a demonstration to the entire class. With proper motivation these are exceedingly interesting even to the teacher.

F. *Filing:*

All material obtained from various departments is filed, then typed bibliography cards are indexed. The following year this material may be used and additions made until the subject is covered according to the ability of the group.

For the benefit of inexperienced teachers the following partial list of reports and demonstrations is appended.

1. How Insects Rank in the Animal Kingdom
2. Morphology of Insects
3. Metamorphosis
4. Aquatic Insects
5. Beneficial Insects
6. Social Insects: Bees, Ants, Wasps
7. Termites
8. Mimicry
9. Mosquitoes
10. House Flies
11. Botflies
12. Dragon Flies
13. Insecticides
14. Chinch Bugs
15. San Jose Scale
16. Corn Borer
17. Beetles
18. Insect Behavior
19. Work of the Bureau of Entomology
20. Insects as Food
21. Insect Traps
22. Ticks
23. Insects Injurious to Greenhouse Plants
24. Moths
25. Butterflies
26. Cotton Boll Weevil
27. Airplane Dusting
28. Figs and Insects
29. Grasshoppers
30. Silk Worm
31. Cockroaches
32. Silver Fish
33. Elm Leaf Beetle
34. Crickets
35. Fleas
36. Fruit Flies
37. Pollination
38. Satin Moth
39. Insect Ecology

Sister Mary Etienne,
Mount Mary Junior College,
Cedar Rapids, Iowa.

NATURE STUDY

"Study Nature, not Books."
—Louis Agassiz.

It was thus that the famous biologist from Switzerland introduced the laboratory method of study. Himself a student of nature and an authority on fish, he was able to show others the way to real understanding and appreciation of living forms through careful study of actual specimens.

What young student of biology today does not thrill with joy at the prospect of field trips, of bringing live plants and animals into the classroom, and watching them develop and grow! He delights in the opportunity to study preserved specimens. It is easy to remember the first part of the motto "study nature" and call it fun. Then he suddenly realizes that biologists, like all other scientists need to record their observations. In his struggle for adequate self-expression he arrives at the decision that even books can be of use. Thus to the discoveries of the past is added the knowledge gained by further observation and experiment. The motto thus modified to the student may be "Study nature, and with the aid of books learn to speak its language."

RUTH A. DODGE.

NATURE STUDY—ALL INCLUSIVE

To the biologist who eagerly seeks his chosen field for more and greater knowledge, to the teacher of biology who since college days has sought only his own major interest, or the newcomer in the field of science education, the mention of nature study brings forth a shower of comments. To many it is so general in its scope that it merely scratches the surface and leaves no foundation. But to the student or teacher of nature study there opens a picture of nature as a whole. As the colors of the spectrum combine to form white light so the branches of nature study form an integral part of the universe.

To the beginner it matters not whether he first observes a living ant, a star, or a fossil bird. Interest paves the way to lasting hobbies. New fields open for alert students as well as teachers. Questions may arise as to the effect of the heavenly bodies on the climate of the earth. This in turn affects living things of the present even as fossils are tangible evidence of life of the past. The particular phase of nature study may well be concerned with the immediate environment and may vary from an interest created by a day at the shore to that of a walk through the mesquite and sagebrush of the desert. To each habitat belong its flora and fauna. Whether it be the birds of the air, the fish of the sea, or the flowers of the woods, each has a story to tell, each presents some biological truth and each is related to the other.

Mother Nature like a book
  Opens wide where all may look.
Some may glance and may not read,
  Others may find fertile seed.
Some her laws may well explain—
  Search for those that still remain.
But some, alas, just look askance
  And wonder why they've had no chance.

RUTH A. DODGE.
Chairman, Nature Study Committee

A LETTER FROM KENTUCKY

At Wayland High School there is the largest high school natural history museum in Eastern Kentucky. It has been collected by the students under my supervision in the past four years. We study biology by seasons; insects in the fall, human biology in winter, and amphibians, reptiles, wild flowers, and fishes during the spring. We plan to build up an herbarium of every flowering plant that occurs in our region.

WILLIAM ADAMS, JR.,
Wayland High School,
Wayland, Kentucky.

The Dallas Meeting

The fourth annual convention of *The National Association of Biology Teachers* was held in the Roof Garden of the Jefferson Hotel, Dallas, Texas, Monday, December 29, in conjunction with the winter meeting of the American Association for the Advancement of Science. President Homer A. Stephens of Madison, Wisconsin presided over the morning program session and the evening banquet. President-elect M. A. Russell of Highland Park, Michigan, the general program chairman, presided over the afternoon session. The practical, well-balanced program of papers, demonstrations and motion pictures was presented as announced in the December issue of THE AMERICAN BIOLOGY TEACHER. A cordial enthusiastic spirit was in evidence at all time. Much credit is due the local committee, whose careful planning made possible the pleasant, efficient and profitable gathering.

The climax of the convention was the thought-provoking banquet address, "Biology, Appraisal and Forecast," by Dr. W. F. Loehwing, Head of the Department of Botany, State University of Iowa. When President "Steve" at the conclusion of the address opened the meeting to questions, the audience showed its appreciation of the "open forum" divergence from usual banquet procedure by its hearty response.

So that those who were not privileged to attend the convention may still share in its experiences, arrangements are being made to print in THE AMERICAN BIOLOGY TEACHER, in full or in part, several of the contributions to the program. Unfortunately, such features as Ottys Sanders' colored slides and vocal imitations of Texas frogs and toads, Ruth Morris' demonstrations of classroom experiments, and Dr. E. Laurence Palmer's motion pictures and records of bird songs cannot be published, but the journal will attempt, within the limits of the printed page, to bring its readers as much as possible of the convention program.

Preceding the general meeting the executive board together with representatives of some of the affiliated locals held its annual business meeting. On the agenda were matters of finance, membership, new affiliated groups and many other items, details of which will appear in future issues of the journal. The board accepted the resignation of Edward C. Colin of Chicago Teachers College as Editor-in-Chief and elected as his successor John Breukelman of The Kansas State Teachers College of Emporia. The editorial board discussed various matters pertaining to the journal and decided among other things to add a National Defense number to the list of special issues. Our first president, M. C. Lichtenwalter, was placed in charge of arrangements for this issue, which it is hoped may be ready for the printer in time for distribution in April.

The 1942 convention will probably be held in New York during the next winter meeting of the American Association for the Advancement of Science.

SPECIAL ISSUES

Biology Clubs - - - - March

National Defense - - - April

Conservation, Consumer Biology, Health and Hygiene, and probably others in the near future.

The Biology of the Stream

JOHN BREUKELMAN
Kansas State Teachers College of Emporia

Many biology instructors overlook the possibilities of a stream, especially a creek or brook, as a teaching aid. They suppose that running water represents a highly specialized environment, that the biology of the stream is too complicated for elementary study, and that the bulk of freshwater life is in the ponds and lakes instead of the streams.

In comparison with other inland habitats, running water is actually rather broadly generalized, for even the most turbulent mountain torrent has some quiet pools and backwater areas. Adjustments of plants and animals to physical environmental conditions are often more obvious in running water than in still water or on land. If there is a stream near enough to be readily available for field observation it should not be neglected.

The suggestions in this paper come from actual experiences of teachers and pupils from kindergarten to university, involving both plains and mountain streams. Any interested teacher can enlarge upon and modify them to fit any particular type of running water habitats available in his own community.

A small stream may be an important source of biological material for general observation, laboratory study, aquarium stocking or preservation for future use. Attached to stones and sticks in swift currents may be found various green algae and water moss. Water cress abounds in spring-fed brooks. Spirogyra and other filamentous algae, Euglena and similar microorganisms live in quiet pools back of large rocks, fallen logs and other obstructions. Arrowweed or arrow-head, reeds, spatterdock and cattails are to be found in side pools and cutoffs. Pondweeds sometimes occur in slow streams. Duckweed and other floating plants may be found in quiet pools and backwaters.

Protozoa of many kinds occur in still pools and among attached algae in currents. Rotifers are frequently associated with them. Sponges are found on submerged sticks in clear cool streams. Hydras are common on vegetation growing in clear water in slow streams or pools in sunny places. In suitable locations they may be found the year around. Bryozoa are found on stones and logs in clear water, either in pools or in currents. They are not prominent in appearance and are often overlooked.

Planaria and similar flatworms are found attached leech-like to the bottoms of stones in moderate to swift currents. Their color often blends so well with that of the stones that they are easily overlooked. There are two common types of roundworms in streams. The almost microscopic nematodes are very generally distributed in slow muddy-bottom streams; the larger hairworms ("horsehair snakes") are found in clear water in pools or slow currents, generally in or above bottom vegetation. Annelids are also represented by two common types, bristleworms and leeches. The former are abundant in muddy bottoms and decaying vegetation; the latter are found in pools, on sticks and rocks in slow streams, and attached to turtles and frogs.

Clams are generally buried in mud or sand in the shallower parts of slow

streams. Their shells are often found on the banks after recession of high water. Their glochidia may be found on the fins and gills of fishes in late spring and summer. Snails occur on rocks, sticks and vegetation near the edges of pools and streams, and on rocks and attached vegetation in slow to moderate currents. Freshwater limpets are closely attached to rocks in moderate to swift currents.

Crustacea are represented in currents chiefly by the everpresent crayfish, but in pools and cutoffs abound daphnids and other of the almost microscopic "water fleas." Many of these are so small as to be overlooked entirely unless special attention is given them. Scuds or benders are found in pools and among attached algae in currents. Water sow bugs or pill bugs are found among dead leaves on mud bottoms. Sometimes in late winter they are almost the only animals to be found in certain of such pools.

Water mites, almost the only regularly aquatic arachnids, are found in cutoff pools and slow streams, generally among pondweeds and similar vegetation. Spiders of various kinds are always present on the shore near the waters edge, especially under rocks near riffles. There are a few true water spiders, and occasionally land spiders venture out on the water, being supported by the surface tension film.

Insects may be found in all stages from egg to adult and in all types of running water. Eggs may be attached individually or in patches to submerged rocks or logs, in floating "rafts," in hollow stems of vegetation and many other places. Larvae of the dobson fly (hellgrammite), caddis flies, leaf caterpillar, water beetles (*e.g.*, water tiger), midges (*e.g.*, bloodworm), mosquitoes and many others, as well as nymphs of damsel flies, dragon flies, May flies and stone flies, may be found by looking

Grade school children collecting specimens in a shallow gravel-bottom stream.

under rocks and submerged objects of all kinds. Pupae of mosquitoes, caddis flies, various beetles and certain diptera are usually present. Among adults to be found in or on the water are backswimmers, water boatmen, water striders, electric light bugs, water scorpions, diving beetles, whirligig beetles; just above the surface are dragon flies, damsel flies, horse flies, crane flies and many others.

Fishes of many kinds are present in all types of streams; minnows, catfishes, suckers, sunfishes and darters are among the most common and characteristic ones.

Amphibia are represented by eggs, tadpoles and adults. Eggs of various salamanders, frogs and toads are found in strings or clumps in side pools; tadpoles may be found in pools and sluggish streams; adults may be found permanently in the water, as the mud puppy or water dog, or at the waters edge ready to jump in when alarmed, as the various species of frogs.

Turtles and snakes of many different species are common in and near streams of all types and sizes. Some, like the softshell turtle and the ribbon snake, are in the water all or most of the time, but in general these reptiles move in and out of the water at will, both for food and for protection from enemies.

Many birds build their nests and spend most of their active time in the timber near streams; a few, such as the herons, kingfisher and water ouzel or dipper, are characteristically found in the immediate vicinity of the water itself.

Such mammals as the beaver and the muskrat are true stream inhabitants; and many others are regularly found in the valleys near the water, as for example certain species of field mice.

Even in the dead of winter streams support a much larger variety of active life than is commonly realized. In eastern Kansas we find the following more or less regularly: green algae, protozoa, hydra, planaria, clams, some with eggs or embryos in the brood pouches, snails, crayfish, "water fleas," water mites, nymphs of dragonflies and mayflies, adult whirligig beetles and backswimmers, fishes of many species, bullfrog tadpoles and adult cricket frogs, the latter only during extended periods of sunshiny weather and only in protected places. In this latitude the stream is also the best place for the study of the winter birds under natural conditions, both from the standpoint of variety and for general ease and efficiency of observation.

Small streams offer exceptional opportunities for observing environmental conditions and changes. The physical factors of temperature, hardness, turbidity, concentration of minerals, oxygen content, acidity or alkalinity, depth, velocity, type of bottom, type of shore and presence and kind of obstructions can be observed and measured or estimated and their effects noted in terms of plant and animal adjustments. Biology can be correlated with chemistry in making certain tests (oxygen content, hardness, etc.) and with physics and industrial arts in the construction and use of devices for measuring and testing.

The sorting effect of the current is observable at any sharp bend, the velocity being highest on the outside of the channel. Here are found the good swimmers. The inside of the curve may develop sand and mud bars, with a variety of slow currents, still pools or backflows. It is at these points that floating vegetation and debris gather, with concentration of microscopic and non-motile life.

Streams have abrupt environmental breaks at dams, sewage outlets and the points at which oil well wastes or mine

refuse is dumped in. Differences in species, number of species and number of individuals may often be correlated with environmental factors. For example, sewage in a stream often results in an increase in the number of animals present; it does not as a rule increase the number of plants. Plants make their own food; animals do not—the correlation here is obvious.

Floods bring about a number of easily observable changes. Land plants adjacent to the stream are covered up; land animals driven out of their usual habitats. Crop plants are sometimes killed or covered with silt; lizards and spiders are forced to higher ground into unnatural surroundings. There is an increase in suspended matter in the water and a decrease in dissolved materials. One student remarked that "flood water is soft and dirty, low water is hard and clean." With the recession comes the trapping of fishes and other aquatic animals in backwaters. We once collected immense numbers of fairy shrimp in backwater covering a gravel road and on another occasion numerous three- and four-inch gar pike in a pool in a wheat field that had recently been submerged.

During drouths streams may be reduced to isolated pools with no running water between. The result is concentration of species and usually elevated temperature and reduction of oxygen content. There is gradually elimination of the less resistant forms and sometimes only microorganisms remain. Exposure to new enemies adds to the hazards of the animals in such pools.

Special conditions exist for some distance below a spring, depending in extent on its size and the chemical nature of the water. Conditions at the mouth of a spring are relatively uniform, so that gradients are set up. For example, spring water is usually considerably below surrounding temperatures in summer and above in winter. In one instance we found water flowing from a spring at 56° F. in January and 58° in July. A station 300 yards downstream had a January temperature of 32° and was up to 84° in July. The distribution of algae, higher plants, planaria, insects, fishes and adjacent land organisms in both cases followed the temperature gradients rather closely.

Stream conditions in winter are of peculiar interest. Students are often surprised to find that the temperature of an ice-covered body of water reaches a definite minimum, namely 4° C. or 39.2° F. The explanation of this involves an excursion into the field of physics. The fact that pools freeze over while the current remains open brings in a whole set of problems. Here are many opportunities for integration of several sciences.

Although most adaptations to aquatic conditions can be studied in still and running water alike, only the stream can illustrate the current itself as an environmental factor. Animals seek shelter under rocks, lay eggs on the downstream sides of rocks, concentrate below dams and other obstructions, try to go over obstructions, hang on to rocks and stems by means of hooks and suckers, attach themselves to other animals, live in adhesive cases or tubes, develop a streamline form although living a sessile life, burrow into bottom mud or sand and make many other responses. The planarian, hellgramite, crayfish, caddisfly, water penny and darter illustrate how locomotion is adjusted to currents. The location of the eggs and young of the leech, crayfish, caddisfly and clam illustrate the modification of the reproductive habits of animals in response to running water. The attached algae in running water offer shelter to many of

the smaller animals that could not otherwise keep from being swept downstream.

While seasonal succession is as a rule not quite so obvious in a stream as in a lake, certain special cases may offer unusual opportunities in this regard. The reestablishment of normal conditions after severe floods or drouths are examples. An interesting project may be set up by submerging a log in a shallow stream, observing it at intervals and noting the gradual establishment of characteristic species of stream plants and animals. Somewhat different is the result of inverting a large rock in a shallow riffle; in this case some of the changes occur immediately. Mayfly nymphs will crawl around to the bottom at once; the algae now on the bottom side will gradually disappear and a new crop will form on the side now on top; the caddis worms may persist on the top side if the cases were well under way at the time the change was made.

If a small enough stream is at hand it may be practical for a class to start an ecological succession by constructing a dam. It need not be more than a foot high to bring about some rather abrupt changes in the species of the immediate area.

Sometimes it is possible to observe stream alterations which are themselves the results of activities of living things. When a stream runs low enough to permit pondweeds to gain a foothold over the bottom its animal population may undergo great changes. Watercress sometimes clogs small streams, both directly by its own bulk and indirectly by causing deposition of dead leaves and other trash. Beaver dams and muskrat nests may cause changes that are far reaching. A beaver dam may impound enough water eventually to support true lake conditions.

Collecting equipment for the stream need not be elaborate. A seine and dip

Collecting Spirogyra from a spring-fed stream near Chicago in January. (Copyright by General Biological Supply House, Inc., Chicago.)

net are essential, but both may be home made. Flat-tipped forceps and wide mouth droppers are convenient for removing organisms from rocks. A sieve for washing worms and other burrowing animals from bottom mud may be made by fastening a piece of window screen over a pail from which the bottom has been removed. Minnow buckets, cans and jars are necessary to whatever extent the individual collecting conditions demand. A low-power microscope and a few watch glasses make it possible to identify many specimens as they are collected, often adding much interest to the work. Material to be preserved is placed in 10% formalin or 70% alcohol. Both teachers and pupils should be dressed in such fashion that they need not feel hesitation about getting wet—this seems to be a rather important point in the success of stream collection.

To obtain a general stream collection one should pull a seine through both pools and currents, set the seine in a swift riffle and turn over upstream rocks, dislodging organisms and sweeping them into the net, use a hand or dip net in close places about logs, bridge piers and the like, examine rocks, submerged stems, stems and general debris carefully enough to spot the smaller specimens, scrape sides of bridge piers and dams, wash bottom sand and mud through a sieve and examine carefully the shore line just above the water. Generous samples of each type of collection should be examined or many of the rare and unusual specimens will be missed.

Material that is to be kept alive should be placed in a relatively large volume of water, and in summer kept as cool as possible. This is especially true of animals from currents. For the aquarium one should select specimens from the quiet pools and slow streams; organisms from the swifter waters seldom survive in confined still water. If the aquarium is equipped with a circulating and filtering device, such material as water cress and brook animals can be kept successfully. To some extent an aerating pump will replace circulation of the water.

It is perhaps not out of place to mention a few legal aspects of field work in general. The field collector, unless he works in such places as public highways, navigable streams, public parks and preserves and school grounds, is a trespasser on private property. He should therefore ask permission from the landowner before he enters on a program of field work. He should also acquaint himself with the laws concerning seines, traps and other catching devices, protection of certain species, open and closed seasons and special arrangements in regard to collecting protected species for scientific and educational purposes. Since laws vary by states (and sometimes by counties and municipalities) no general statement can be made. The interested teacher can find out from his own state department in charge of wildlife and its conservation. In this connection the field biology of the stream often presents opportunities to do some constructive conservation teaching.

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Biological Briefs

Kienast, Margate. *War on Creeping Poison.* Nature Magazine 34: 434–437. October, 1941.

The effects of poison ivy have been known and publicized since the records of Captain John Smith; yet with a concerted drive the weed could be almost eradicated within a short while. Sensitivity to its irritating oils is sometimes inborn and at other times may develop after years of immunity. In order to produce the characteristic burning, itching skin eruption, the oil must make direct contact with the skin, either directly from the leaves or in the smoke from burning plants. To be eradicated, the plant must be cut off as close as possible to the ground, repeating the process two or three times until the underground stems no longer send up new shoots. Sodium chlorate, sprayed on the leaves or scattered as dry salt on the ground, will destroy it. Where there is no danger of poisoning domestic stock, arsenicals may also be employed as sprays. To oxidize the irritant, vanishing cream containing 10% sodium perborate should be used on the skin before exposure. After possible contact with the plant, skin and clothing should be thoroughly scrubbed with soap.

Beebe, William. *Animal Doors.* Bulletin of the New York Zoological Society 44: 114–116. July–August, 1941.

Doors to exclude enemies from the animal home may be a portion of the animal itself or may be manufactured. The head of a boring beetle stops up the opening to its tunnel in a tree, while the hermit crab effectively blocks the openings of a great variety of borrowed mollusc shells with its large claw. A modified collarbone serves the box turtle as a door, while the armadillo uses its head, and its relative, the South American pichiciago, stops up its burrow with its scaly posterior. The trap-door spider compounds the door to its home of successive layers of sand and silk. The mormot upon hibernation blockades its burrow with stones and moss. Tube worms and topshells exhibit exquisite opercula, marvels of intricate sculpture when viewed under enlargement.

Coe, John Edwin. *Hydroponics and Auxins.* School Science and Mathematics 41: 629–637. October, 1941.

The minerals necessary for nutrient solutions in soilless plant culture may be grouped into the macro-elements, which include nitrate, phosphate, sulfate, potassium, calcium, and magnesium, and the micro-elements boron, manganese, zinc, copper, and iron. Nitrates assist in the formation of proteins and hence favor foliage growth but retard ripening, while phosphorus hastens root growth and ripening. Potassium is essential to stem growth, photosynthesis, and assimilation. Calcium stimulates protein formation and root growth and strengthens cell walls. Magnesium, iron, and copper are necessary for chlorophyll formation; boron and silicon, for seed development. Control of acidity and total concentration of the solution, as well as maintenance of proper con-

ditions of temperature and insolation, are likewise necessary. Hydroponic methods are being used commercially to increase size and yield in fruits and vegetables; recently, the growth of oriental drug plants no longer available by import and the sprouting of grains for fodder have been instituted.

The growth-accelerating substances of plants, or auxins, control plant activities. They may be grouped as the vitamins, of which A, B_1, C, E, and G are essential; the hormones, which control development of plant organs; the heteroauxins such as phenyl acetic acid and indole butyric acid which when applied hasten rooting and counteract dormancy, and colchicine which induces polyploidy; and the inorganic auxins including ethylene gas which yellows citrus fruits and initiates root growth. Honey contains auxins powerful enough to cause evergreen seeds soaked in it to germinate within a day instead of the normal period of several years.

RUTH SHERMAN STEIN.

The Teacher as a Leader

When you first leave the city,
Roads lead many ways.
Unless you're under guidance
You may end in a maze.
Your search for greater knowledge
May lead through paths unknown
And train some ardent students
To go their way alone.

When you approach the city,
As all roads lead to Rome.
Not one, but many methods
Will guide the student home.
If you are but the leader,
Your strength and courage show;
Whichever path you follow
As you lead, the students go.

RUTH A. DODGE.

Amount and Nature of Biology Teaching in Secondary Schools: Data from a Questionnaire

DR. OSCAR RIDDLE
Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor, N. Y.

(*Continued from January*)

CHANGES AND CONDITIONS RELATING TO BIOLOGY IN THE CURRICULUM

Units of biology added to or dropped from curriculum during past 10 years. The unfortunate wording of a question intended to provide data concerning recent gains or losses of units of biological science in the school curriculum considerably weakens the value of the replies obtained on this subject. "During the last 10 years the total amount of biological science taught in our school has been: —— increased, —— decreased; —— unchanged. The chief changes were —— ——." Their specification of changes (when this was done) showed that very many teachers regarded an increased *enrollment* of pupils (which is of course quite general) as warranting their checking in the space for "increased." But others who checked "increased," probably for the same reason, failed altogether to state the nature of the changes; thus some, probably many, of this group of replies wrongly recorded a school as having recently increased the number of units of biology taught. The question was properly understood by fewer than the 1,649 teachers whose replies are recorded in Table 2. The replies which record "decreased" amounts of biology offered do in fact represent the recent loss of units from the school curriculum in practically all cases; per-

TABLE 2

Changes during last 10 years in amount (units offered) of biological science in high schools

Region	Public				Parochial			Private		
	Unchanged	Increased	Decreased		Unchanged	Increased	Decreased	Unchanged	Increased	Decreased
			Number	Per cent						
Total U. S.	891	394	221	14.7	32	19	1	55	33	3
New England	27	25	4	7.1	1	0	0	13	7	0
Mid. Atlantic	197	149	99	22.2	8	8	1	11	15	0
Southern	114	32	17	11.1	2	0	0	1	3	0
Central	473	124	77	11.4	18	7	0	23	8	2
Western	80	64	24	14.3	3	4	0	7	0	1
Sp. large cities	30	13	67	60.9						
All large cities	94	62	88	36.0						
Small cities	134	92	41	15.4						
Towns	250	116	45	10.9						
Rural	413	124	47	8.0						

centages calculated on these values are therefore essentially accurate and only these can be discussed profitably. These "decreases" are verified by another body of data (Table 4).

In the public schools of the United States 14.7%—or 1 in 7—teachers report that a unit of biological science has been dropped from the curriculum of their school during the last 10 years. This decrease seems to have been most frequent in Middle Atlantic states (22.2%) and least in New England (7.1%)—where least biology is now taught. The nine special large cities show a huge frequency of decrease (60.9%); for all large cities the frequency of decrease is 36.0%. Rural communities show the lowest frequency of decrease (8.0%). Indeed it appears that a direct relation exists between the size of the community and the extent to which the school curriculum has dropped one or more units of biological teaching during the past 10 years. When corrected for inequalities of representation of groups in our data it would appear that for all public schools the frequency of this loss is not 14.7% but about 10%.

Community or school pressure to increase or decrease the amount of biology taught. It was anticipated that the biology teachers of the country would supply two kinds of very useful information relative to this question. First, a statement of the extent to which pressure exists to increase or decrease the amount of biology offered in their school curriculum. Second, a statement of the nature or basis of that pressure. Though these points would seem to touch both the personal and professional interest of the biology teacher—and are things on which he is presumably informed—fewer than one out of three teachers (1,013) replied to either aspect of this inquiry.

A summary of the quantitative aspect of these replies is given in Table 3. Replies indicating pressure to increase the amount of biology taught are subject to the serious unreliability already noted in relation to the data for Table 2; for this reason they are not discussed here. Pressure to decrease the amount of biology now taught in the public schools was recorded by 20.8% of the teachers. This pressure was greatest in the Middle Atlantic states (35.3%) and least in the South (11.3%). Largest also in special large cities (62.8%) and all large cities (50.5%); least in towns (10.3%) and

TABLE 3

Recorded cases of pressure (from community or school) to increase or to reduce the amount of biology taught in schools

Region	Public				Parochial			Private		
	No pressure	To increase	To decrease		No pressure	To increase	To decrease	No pressure	To increase	To decrease
			No.	%						
Total U. S.	274	463	194	20.8	5	12	7	8	37	4
New England	5	27	6	15.8	0	0	0	2	11	2
Mid. Atlantic	57	86	78	35.3	1	3	3	2	12	1
Southern	40	62	13	11.3	1	0	1	2	3	0
Central	130	215	69	16.7	3	1	7	2	10	1
Western	42	73	28	19.6	0	2	2	0	1	0
Sp. large cities	16	19	59	62.8						
All large cities	35	57	94	50.5						
Small cities	58	111	39	18.7						
Towns	69	139	24	10.3						
Rural	112	156	37	12.1						

rural (12.1%) communities. Comparison of these percentages with those in Table 2 for reductions that have actually occurred will show a marked parallelism in the two groups of data. This is the more notable since 1,649 replies are the basis of the one set of data and only 1,013 replies are available for the other.

Though the reasons for or sources of these pressures are very inadequately given the spread of these reasons is too wide to permit a tabular treatment. In general, the following items are frequently cited, from many or most regions of the country, as favoring an increase in the amount of biology taught: student demand, biology teachers (myself), practical aid to conservation, agriculture, forestry or health, increased enrollment, administration, and better equipment. Among the items more frequently listed as having tended hitherto to reduce the amount of biology taught are: crowded or enlarging curriculum, commercial subjects wanted, course too expensive, administration, general science or social science has reduced enrollment, lack of segregated classes (South), curriculum committee, other subjects important, too difficult for students, education professors in training schools, and conflicts of programs.

A related question asked teachers to indicate the local conditions or agencies which would most effectively favor or oppose the *addition* of one, two or more years of biological study to the curriculum of their own school. This much-desired comment was again supplied only in restricted amounts, and in a variety that does not lend itself to helpful summary. The comment usually employed terms quite like those employed in reference to the previous question. Added favorable items are: conservation sentiment, medical groups. Additional opposed items are: teachers of rival subjects, requirements for graduation or for college entrance, one or another church group, and taxpayers.

The small number of replies accorded these questions doubtless reflects the earlier noted fact that only 53% of the teachers indicated that their special preparation was to teach "biology." Impressions gained from a survey of the comment of teachers on these two questions are (a) that the biology teacher is often almost or quite alone in his interest

and effort to extend or expand the amount of biological science taught in his school, (b) that rather frequently he finds himself unable to maintain the amount of the subject earlier taught; and (c) that perhaps only a movement in which all natural science teachers work together with educators and administrators can hope to preserve or secure adequate instruction in this science in our schools.

Substitution of a "social study" for a biological study during past 5 or 10 years. The 2,472 replies relating to this topic are grouped in Table 4. For the country as a whole this substitution is indicated by 11.6% of the replies; for all public schools sampled it is 12.1%; it is apparently less for the inadequate samples of parochial (7.2%) and private (4.0%) schools. On a regional basis this displacement of a biological study in the school curriculum by a "social study" was most marked in Western (19.3%), Middle Atlantic (15.5%), and New England (13.6); least marked in Southern (6.4%) and Central (9.7%) states. On the basis of community size it was far greater in special cities (32.9%) and all large cities (25.6%) and least in towns (6.3%) and rural (8.3%) schools. Here again a complete sample of all schools would probably show not 11.6% but nearer to 10%.

In general, it is evident that during the past 5 or 10 years the large cities have led in a movement which has already substituted a "social study" for a biological study in (almost) 1 of 8 of the high schools reported here. For a group of nine special large cities the proportion is nearly 1 of 3. Since, in our data, the schools of larger cities are relatively better represented than are rural schools a complete sample of schools of the country would show less substitution than is indicated by the above figures. Though fewest substitutions are recorded by the smaller communities they have been made—are now doubtless being made—in communities of all sizes and in all geographical regions of the United States.

Units of biological subjects transferred during the past 5 or 10 years to teacher of physical education. Data on this topic are supplied in Table 5, where it is found that a total of 2,590 units of biological science transferred to a teacher of physical education is reported by a practically equivalent number of teachers (some schools report one-half

TABLE 4

Schools substituting a "social study" for a biological study during the past 5 or 10 years

Region	Public			Parochial		Private	
	Yes		No	Yes	No	Yes	No
	Number	Per cent					
Total U. S.	276	12.1	1998	5	64	5	124
New England	18	13.6	114	0	0	0	33
Mid. Atlantic	83	15.5	457	0	18	1	36
Southern	19	6.4	276	1	6	3	8
Central	97	9.7	904	3	33	1	38
Western	59	19.3	247	1	7	0	9
Sp. large cities	56	32.9	114				
All large cities	114	25.6	331				
Small cities	60	12.9	404				
Towns	37	6.3	549				
Rural	65	8.3	714				

TABLE 5

Number of units (approximately equal to number of replies) of biological subjects transferred during the past 5 to 10 years to teacher of physical education

Region	Public			Parochial		Private	
	Transfers		Replies saying no transfer	Number units transferred	Replies saying no transfer	Number units transferred	Replies saying no transfer
	Number units	Per cent					
Total U. S.	491	20.4	1911	8	69	13	98
New England	13	10.1	116			2	2
Mid. Atlantic	97	17.1	470	6	20	2	39
Southern	35	11.8	263		7	1	8
Central	240	22.5	825	1	36	8	37
Western	106	30.9	237	1	6		12
Sp. large cities	78	35.5	142				
All large cities	171	33.6	338				
Small cities	86	18.4	381				
Towns	105	16.4	534				
Rural	129	16.4	658				

unit, others up to two units). Such transfers are noted in approximately 19.8% of all replies, and in 20.4% of replies from public schools. The percentage seems smaller in parochial (10.4%) and private (11.7%) schools. Western (30.9%) and Central (22.5%) states had most such transfers and fewest are found in New England (10.1%) and Southern (11.8%) states. The special large cities (35.5%) and all large cities (33.6%) again show a large excess over the smaller cities (18.4%) and lesser communities (16.4%).

Only 289 replies specified the titles of the units which were thus transferred. In 177 cases this was hygiene or health. The other specifications were: biology, 57; physiology, 38; general science, 7; all other biological subjects, 10 (life science, 2; zoology, 1; sex education, 1). It thus seems probable that rather more than half (61%) of the transfers that have occurred relate to subjects (hygiene, sex education) which a teacher trained in physical education may be expected to teach as well as or better than a teacher trained in biology. For approximately 39% of these transfers, however, the presumption is in the opposite sense; unless, indeed, the biology teachers concerned here were untrained in biology.

INDICATIONS AS TO THE QUALITY OF THE BIOLOGICAL INSTRUCTION

A series of six questions was asked with a view to getting some information concerning such things as the quality of the teaching, evidence of "successful" teaching, teacher deficiencies, and restrictions placed by others upon the teacher. It is obvious that information of this kind is difficult to obtain; the difficulties of an objective evaluation of such information are also entirely evident. Nevertheless the data from this segment of the questionnaire are of primary importance to those who would strive to improve the teaching of biology on the basis of a knowledge of its present points of weakness or of failure.

Special types of biology clubs in schools. It was thought that the presence of a "biology" club in a school provides evidence of at least one sort of success achieved by biological teaching in that school. A nature study or a bird study club may do the same thing, and such clubs, even in large schools, would

be known to teachers specially trained either in the zoological or botanical aspects of biology. A *science* club is also likely, though perhaps less definitely, to mirror success in biological teaching. Only these particular clubs are represented in Table 6. In very large schools a teacher of either zoology, botany, general science or physiology may not be expected to know and set down the names of numerous special clubs. Precisely because so many of these very specialized clubs exist in the schools of the large cities, and because such clubs are not included in our tabulation, the clubs listed for large cities are far less than their actual total of "biological" clubs.

TABLE 6

Number of science, nature study, bird study and biology clubs (other types, *e.g.*, microscopy, botany, etc. excluded)

Region	Number of replies	Public				Parochial				Private			
		Science	Nature study	Bird study	Biology	Science	Nature study	Bird study	Biology	Science	Nature study	Bird study	Biology
Total U. S.	1,932	817	310	135	479	25	6	6	20	46	9	9	24
New England	102	42	12	2	37	....	....	....	....	11	....	5	2
Mid. Atlantic	525	247	133	43	175	11	2	2	12	16	4	2	5
Southern	235	119	22	8	44	4	....	....	....	2	1	1	1
Central	826	306	113	69	194	9	4	4	7	14	4	1	16
Western	244	103	30	13	29	1	....	....	1	3	....	....	....
Sp. large cities	218	70	78	22	149								
All large cities	467	177	119	38	212								
Small cities	452	203	78	32	117								
Towns	512	250	59	40	86								
Rural	501	187	54	25	64								

In viewing the table it is notable that only 1,932 teachers provided replies and only 245 stated their schools had no such club. Since 2 of each 5 teachers failed to check any part of this question, and there is some evidence that these failures were usually for schools without clubs, the data are not particularly definite or instructive. Nevertheless, the fact that 1,886 clubs with these special designations (in addition to clubs bearing other names) are reported in 87% of 1,932 replies strongly suggests that the teaching of secondary school biology, in all community types and regions, is often effective in the sense that it stimulates the interest of pupils.

Topics teachers would emphasize in a course in general biology. Teachers were asked "to list the 4 or 5 topics on which they would place *most* emphasis in a high school course in *general biology.*" It was thought, and it is now believed, that replies to this question should throw much light on both trends and present effectiveness of biological teaching in our schools. From one-third of the total number of questionnaires returned—from the public schools in 15 states representing all regions of the country—these topics for emphasis have been classified, counted and tabulated. A total of 3,035 entries or topics (3.5 topics per teacher) were thus set down by 866 (79.6%) of the 1,088 teachers who sent in replies from these 15 states.

Excluding such items as "animals," "botany," "biology"—which were set down as "topics" with surprising frequency—only 23 topics were stated 13

or more times. Those 23 topics are arranged in numerical order in Table 7. Some hundreds of different additional topics (including stars, planets, neatness, posture, hobbies, fertilizers, pollination, pets, etc., etc.) were mentioned one or more times for a total of 1,012 entries. Table 7 shows that the topics most frequently listed were: health-disease-hygiene (397), physiology (263), heredity (192) and genetics (90), conservation (127) and structure (102). The least popular among these 23 major topics were photosynthesis (13), biological principles (13), scientific method (21), behavior (29), eugenics (31), adaptation (37) and evolution (39). Somewhat more popular than the latter group of subjects were economic biology (50), insects (53), nature study (87) and taxonomy (88).

Though the very large amount of highly informative material obtained on this item shows that many teachers of biology throughout the country have a sound grasp of their obligation and opportunity to teach a science, the data as a whole also clearly show widespread tendencies to teach biology not as science but (a) as a way to pleasing hobbies, or (b) as a series of practical technologies. These tendencies involve and raise several serious questions and a short statement of personal opinion will be recorded.

It may be highly desirable—the reviewer of these results thinks it is—to teach high school pupils a great deal of the very practical in hygiene, in conservation, in nutrition, in animal husbandry, in sanitation, in economic biology, etc. But even if this be granted there are two cogent reasons why no one, nor any group, of these applications of biology should become a dominating interest during the first one or two years which a high school pupil devotes to biological science.[2] The first reason: When taught as a science, the contribution of biology to the education and mental discipline of an educable pupil is incomparably greater than when taught as a smattering of its applications. Second, the biological technologies will hang more superficial than his skin on any pupil smeared with them prior to an introduction to the basic facts which relate and anchor them. This principle is and has long been axiomatic at the college and university level for training in technologies of every sort —medicine, engineering, forestry, and the rest. Everywhere the rule is: the basic sciences or principles first, applications afterward. Unless or until educators and school administrators comprehend this principle our secondary school biology will become (or remain?) a happy hunting ground for whims, fads and various forms of so-called practical or useful knowledge. Whatever may be said for the great value to high school pupils of the applications of biology—and it is a convincing prospectus—is in no sense an argument that such teaching should displace the teaching of the science of biology; rather it is an argument for the addition of one or two more years to the amount of biology now included in the high school curriculum. That addition would permit a study of applications to follow a study of the science.

Teaching or not teaching the genetic inequality of human beings. It would perhaps be difficult to exaggerate the social and political importance of this principle of modern biological science. Even adherence to the principle is banned in communist Russia. It seemed

[2] This statement has no bearing on the obvious desirability of using the commonplace and familiar in all teaching, whether in science or in technology.

TABLE 7

Topics teachers would emphasize in a high school course in "general biology"

	Health—Dis.—Hyg.	Physiology	Heredity	Conservation	Structure	Genetics	Reproduction	Taxonomy	Ecology	Nature study	Environment	Insects	Nutrition	Economic biology	Life processes	Sex education	Evolution	Adaptation	Eugenics	Behavior	Scientific method	Photosynthesis	Biol. principles	No of replies (and blanks)	
Alabama	16	9	12	4	4	2	4	4	5	4	5	3	4	1	7	1	0	1	2	1	0	0	0	33	(14)
Arizona	2	2	1	0	2	0	2	1	1	1	0	0	1	0	0	2	0	0	0	1	0	0	1	7	(3)
Arkansas	4	1	2	3	0	0	0	3	0	1	0	0	0	0	1	0	(1)	0	0	0	0	1	0	8	(2)
California	65	36	27	17	5	19	18	10	8	18	11	6	7	4	7	10	7	3	4	4	6	2	0	141	(24)
Colorado	11	8	3	3	3	2	1	4	3	3	2	1	1	1	5	2	2	1	1	1	0	0	1	24	(5)
Florida	4	2	1	1	4	4	1	2	2	0	1	0	0	1	0	1	0	0	0	0	(1)	0	0	11	(7)
Georgia	5	1	2	2	1	0	3	0	1	1	1	1	4	0	1	0	0	1	1	0	0	0	0	9	(3)
Idaho	8	5	5	2	3	2	0	2	0	2	0	1	0	1	2	2	2	0	2	0	0	0	0	16	(6)
Indiana	71	57	47	25	23	21	9	25	21	23	13	14	8	7	10	4	4	5	5	5	3	3	3	102	(23)
Louisiana	4	0	0	0	2	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	1	6	(5)
Massachusetts	31	32	8	10	11	8	5	9	6	4	4	2	1	9	1	1	7	3	2	2	4	2	2	66	(16)
New Jersey	31	16	10	4	8	4	7	2	5	5	3	4	4	10	1	4	2	4	1	2	3	0	1	65	(15)
Ohio	76	66	40	35	16	17	17	10	11	15	13	14	12	6	9	13	9	10	6	8	4	4	3	175	(40)
Oregon	18	8	7	5	5	2	3	5	3	3	1	1	0	2	1	1	1	0	3	1	0	0	0	30	(3)
Pennsylvania	51	20	27	16	15	8	20	11	22	7	12	5	10	7	4	4	4	9	4	4	0	1	1	173	(54)
Totals	397	263	192	127	102	90	90	88	88	87	67	53	52	50	49	45	39	37	31	29	21	13	13	866	(220)

highly desirable to learn the extent to which this generalization is brought to our high school pupils by (a) the biology teachers reporting, or (b) by "other biology or social study classes in the school." The data are summarized in Table 8.

Replies to the question were received from 87.9% (2,551) of all teachers in the public schools, from 68.7% (68) of the parochial, and from 89.7% (165) of the private schools. Teachers in parochial schools thus avoided a reply to this question to an unusual degree, and of those replying 35.3% say they do not teach this principle; only 12.9% of teachers in private schools, and 14.1% of teachers in public schools say they do not teach it. There is here probably also a significant difference between the public schools of different geographical regions. The percentage of failures to teach this principle is high in Southern (22.8%) and New England (22.6%) states and notably lower in Western (11.5%), Middle Atlantic (11.6%) and Central (12.6%) states. Community type and size seem of less significance: Special large cities (11.8%), all large cities (13.0%), small cities (14.7%), towns (12.2%), and rural (15.8%).

Superficially these figures, excepting those relating to parochial schools, do not seem particularly discouraging. When, however, it is remembered that (a) so little time is accorded to the entire field of biology, (b) that only 53% of these teachers say they specially prepared to teach biology, (c) and that all real understanding of this principle requires some instruction in genetics, one may doubt that the instruction often penetrates—and really succeeds in giving to our youth this scientific truth of prime importance to social and political thinking.

If we examine the data obtained for "taught in some other biology or social study course," and for "not taught in our school" this should be done with the understanding that these two items formed a second and third part of the question and that most teachers who replied to the first part of the question ("is taught, or not taught, in my classes") failed to check the later items. In an examination of these individual replies the reviewer only rarely finds

TABLE 8

Teaching or not teaching the genetic inequality of human beings

Region	Public				Parochial				Private			
	In my classes		Taught in other class	Not taught in school	In my classes		Taught in other class	Not taught in school	In my classes		Taught in other class	Not taught in school
	Taught	Not taught			Taught	Not taught			Taught	Not taught		
Total U. S.	2,191	360	417	284	44	24	10	17	135	20	18	19
New England	103	30	13	25	1	....	....	....	36	3	7	1
Mid. Atlantic	511	67	81	60	14	5	2	6	37	7	4	6
Southern	256	76	35	52	5	3	2	1	9	2	1	1
Central	1,029	149	209	120	18	16	6	10	42	6	5	9
Western	292	38	79	27	6	....	....	....	11	2	1	2
Sp. large cities	194	26	32	19								
All large cities	400	60	76	48								
Small cities	424	73	108	49								
Towns	600	83	108	71								
Rural	767	144	125	116								

evidence that the "social studies" taught in our secondary schools include any consideration or reference to this basic biologic inequality of human beings. The deficiency may reside in our data. The data obtained for this entire topic, however, strongly suggest that the education of our future citizens in our high schools usually fails to make them aware of the inherent inequalities of individuals and of the consequences of this to communities and the state.

(To be Continued in March)

Books

GRIFFIN, ELDON. *Oysters Have Eyes;* or *The Travels of a Pacific Oyster.* Wilberlilla Publishers, Seattle, Wash. 53 pp. 1941. Paper, $1.00.

Despite our increasing knowledge of the oyster there is very little of this information available in a form for use in high school biology, and this booklet does not go far in supplying the deficiency. It is an "informal account," designed to tell the layman "all about" the oyster business in Willapa Bay, California. It "touches on science, economies, history, art and other fields," according to the author's own words, and should delight the soul of the intregrationist.

In spite of the lack of straight biology and the resort to anthropomorphism, it is good reading. The author seems to have had a good time writing it. For a layman's account, it is unusually accurate—except on the few occasions when the author tells what he has heard about eastern and gulf oysters—and is especially informative on the transplantation of the Japanese oyster to California waters B. P. H. (Before Pearl Harbor).

There is neither index nor bibliography.

G. W. JEFFERS

DEBOER, JOHN J., editor. *The Subject Fields in General Education.* D. Appleton-Century Co., New York. ix + 239 pp. $1.50.

This book is a report of the National Commission on Coöperative Curriculum Planning. Its purpose is to present general principles for the improvement of teaching in the high school. There are eleven chapters written by and for teachers of social studies, English, journalism, speech, foreign languages, natural sciences, mathematics, home economics, physical education, business education, and art. The last two chapters discuss the school library and "Our Emerging Life-Centered Curriculum." The editor notes that "not all of the reports have been officially endorsed . . . , but all of them represent the mature thinking of authorized committees, and may be regarded as official or semi-official statements."

There are few specific suggestions for day-to-day classroom teaching methods. General principles are presented as guides in the selection of subject matter and teaching procedures. Emphasis falls on three needs in high school teaching: 1. better trained, better informed teachers; 2. more consideration of pupils' developing personalities and less of isolated information; 3. more use of the pupil's own life experiences in his own community. In order to supply these needs the committee recommends that teacher training institutions provide more opportunities for students to see the inter-relationships among specialized fields of knowledge. For high school teachers in service the committee recommends that each teacher keep informed of the objectives of all other teachers and adjust his teaching to the personal and social needs of individual pupils. "Each teacher," says the chapter on social studies, "is expected to assume responsibility for the entire field of unspecialized knowledge."

GEORGE C. JOHNSON,
State Teachers College,
Emporia, Kansas

ELECTION NOTICE

Nominations for the year 1942–1943:

(Biographical sketches prepared by Miss Betty Lockwood, chairman of the nominating committee.)

For President-elect:

Miss Helen Trowbridge, Glen Ellyn, Ill.: biology instructor in Glenbard Township High School, Glen Ellyn, Ill.; graduate of University of Chicago, M.S., University of Michigan, graduate work at University of Chicago; member Illinois Biology Teachers Association, Illinois Curriculum Committee, Chicago Biology Round Table; associate editor and contributor THE AMERICAN BIOLOGY TEACHER; First Vice President N.A.B.T. 1940–41; chairman Regional Meeting, Chicago, 1941; Chicago Round Table representative to N.A.B.T. Convention, Dallas, Texas, Dec., 1941.

Mr. William A. Betts, Austin, Texas: teacher in Senior High School, Austin, Texas; B.A., M.A., University of Texas; member Texas Association of Science Teachers and editor of their publications; associate editor and contributor THE AMERICAN BIOLOGY TEACHER, chairman of committee for the Visual Aids Issue; author of articles

in other scientific journals; First Vice President N.A.B.T. 1941–42.

For First Vice President:

Mrs. Ruth Sherman Stein, Los Angeles, Calif.; teacher of biological sciences, Los Angeles City Schools; B.A. and M.A. degrees in zoology, University of California; teaching assistant in zoology, U.C.L.A.; training at Yosemite School of Field Natural History; charter member of Southern California Association of Life Science Teachers; associate editor THE AMERICAN BIOLOGY TEACHER, contributor to Biological Briefs.

Mr. Paul B. Mann, New York City: A.B., A.M., Cornell University, where he later taught zoology; teacher, College of the City of New York, 8 years; head of Biology Department, Evander Childs High School, 27 years; Supervisor of Science in senior high schools of New York City 1936–38; on staff of American Museum of Natural History 1928–38; past president, New York Association of Biology Teachers; Member New York Academy of Sciences, American Association for the Advancement of Science; biography in Who's Who in America, American Men of Science; author of *How To Tell the Weather, Out of Doors, Biology for Beginners, Biology* (the last three in collaboration).

For Second Vice President:

Miss Eva B. Ammidown, Boston, Mass.: A.B., Mt. Holyoke College; M.S. in Education, Harvard University Graduate School of Education; teacher of biology, chemistry and physics in secondary schools; head of department in Teachers College of the City of Boston since 1927; summer teacher at Massachusetts Institute of Technology; chairman of program committee of New England Biological Association; delegate to 1940–41 meeting of N.A.B.T.; member of American Association for the Advancement of Science; assisting in revision of biology course in Boston high schools.

Mr. Prevo L. Whitaker, Terre Haute, Ind.: Biology teacher in Terre Haute high schools for past 6 years; A.B. and graduate work from Indiana State Teachers College; first President of West Central Indiana Biological Society, Secretary-Treasurer 1938–41; representative to N.A.B.T. convention in 1938; assisted in affiliation of state group with N.A.B.T.; Secretary, Indiana State Teachers Association, 1939, President, 1940.

For Secretary-Treasurer:

Mr. P. K. Houdek, Robinson, Ill., the present holder of this office.

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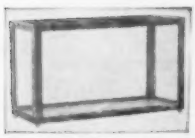

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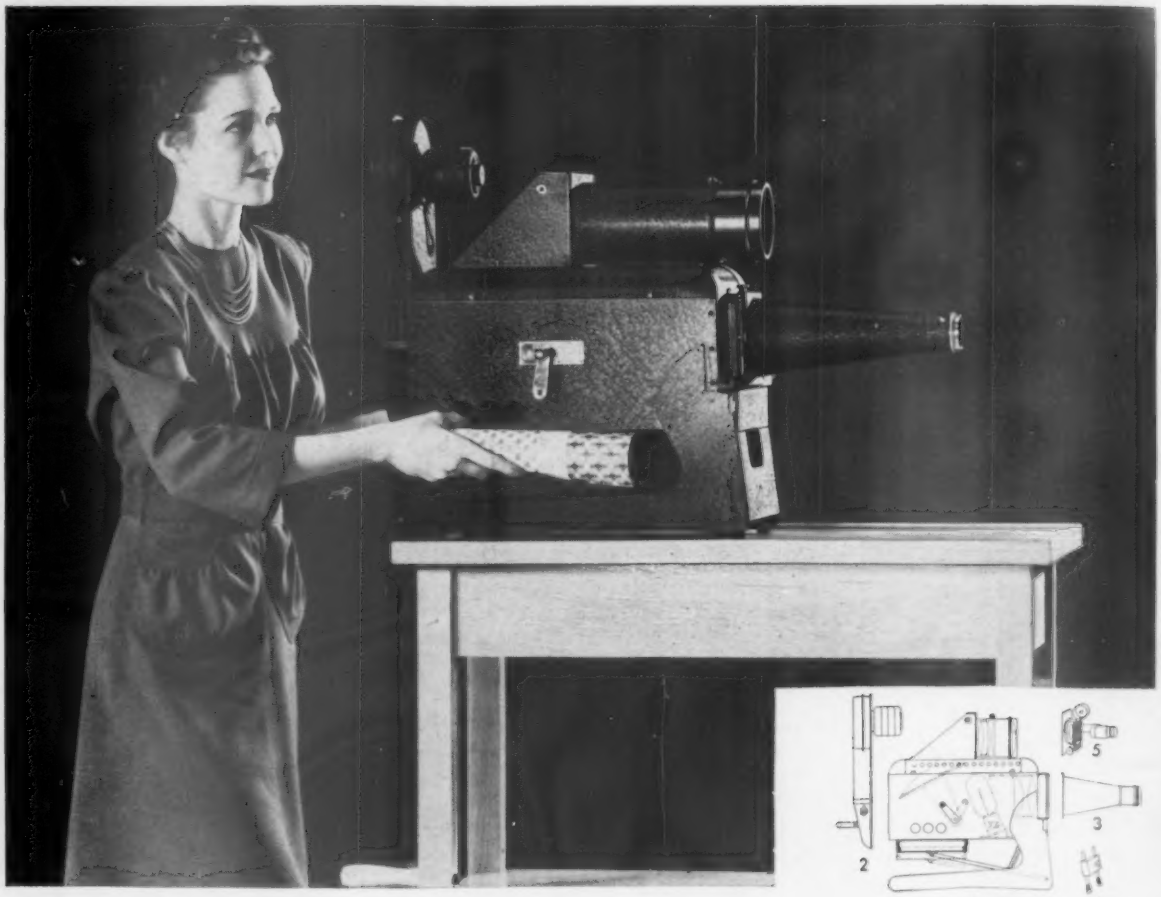

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